

Truth: Clusters are individually complex

Beauty: Global “Obs–M” relations and spatial distribution offer superb cosmological probes when enough clusters are used [STRATEGY]

...and a mess: Counting “decisions” and systematics in the observational selection functions [REALITY]

The Chandra Fornax Survey (0.5Msec, 10 fields)

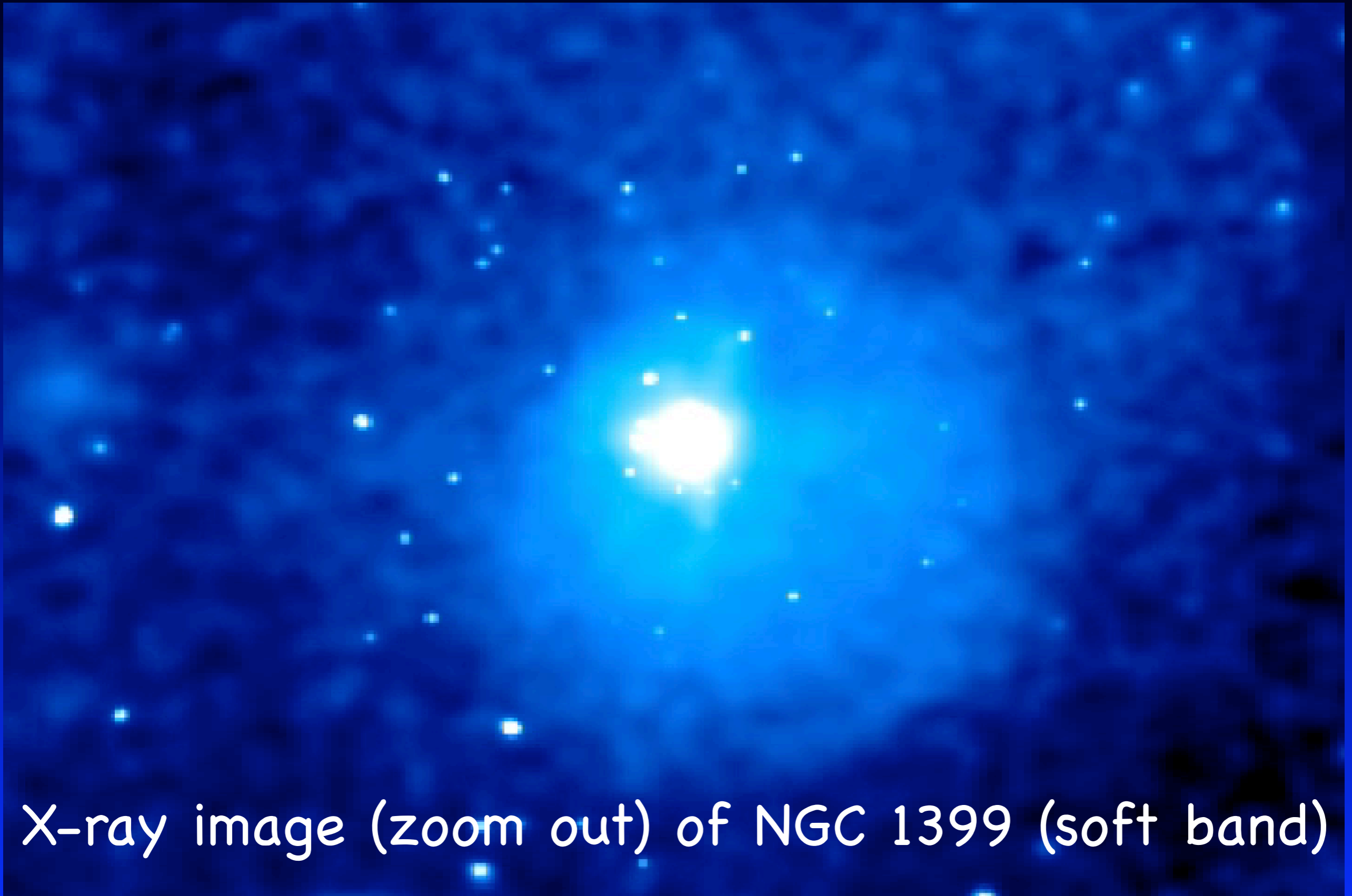
Stills from movie shown in talk

An optical image of the central galaxy NGC1399, showing a bright, yellowish-white core surrounded by a diffuse, orange-red glow. The background is dark with numerous small, distant stars visible.

Optical image of central galaxy NGC1399

Scharf, Zurek, Bureau (2004)

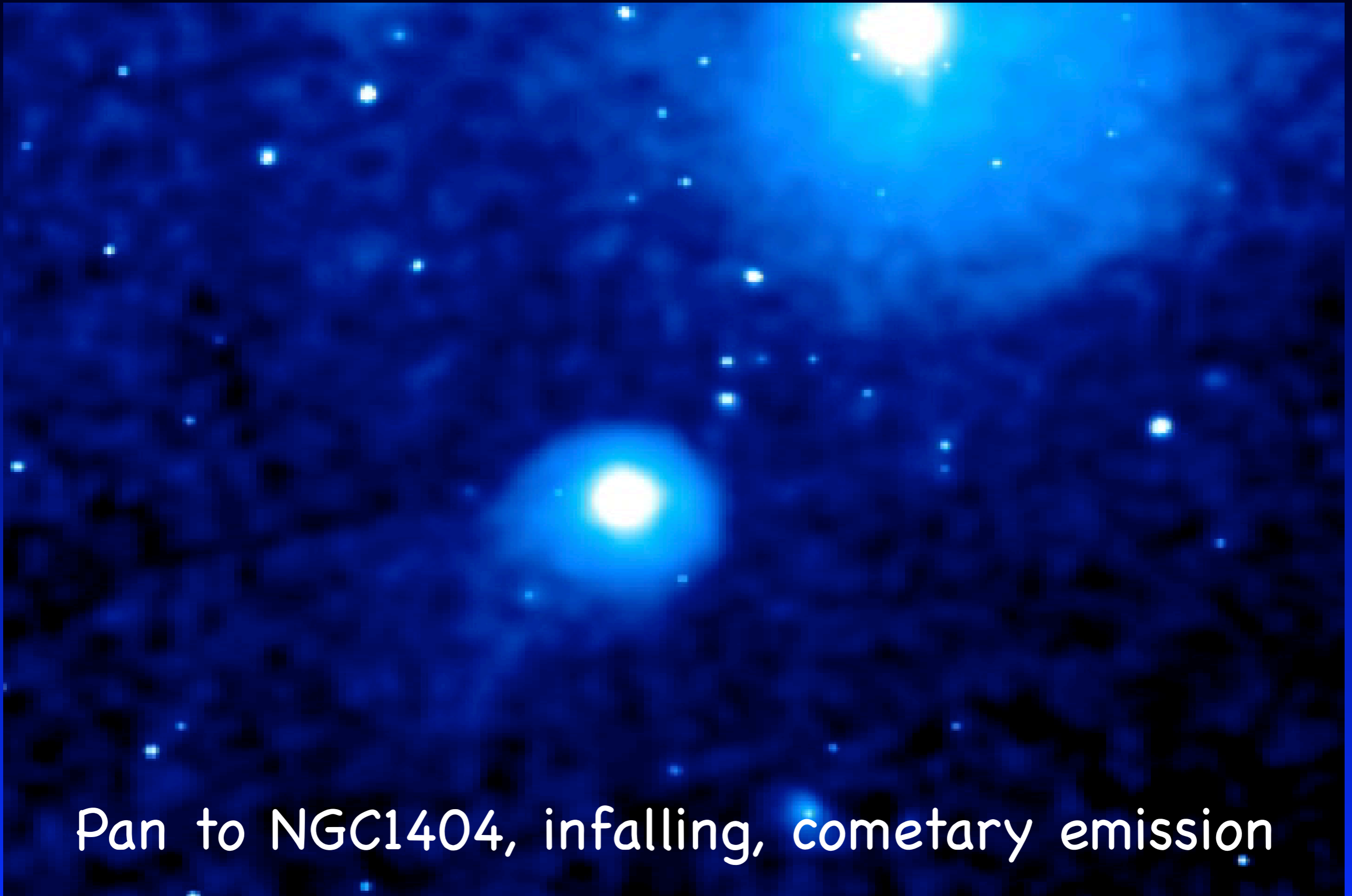
The Chandra Fornax Survey (0.5Msec, 10 fields)



X-ray image (zoom out) of NGC 1399 (soft band)

Scharf, Zurek, Bureau (2004)

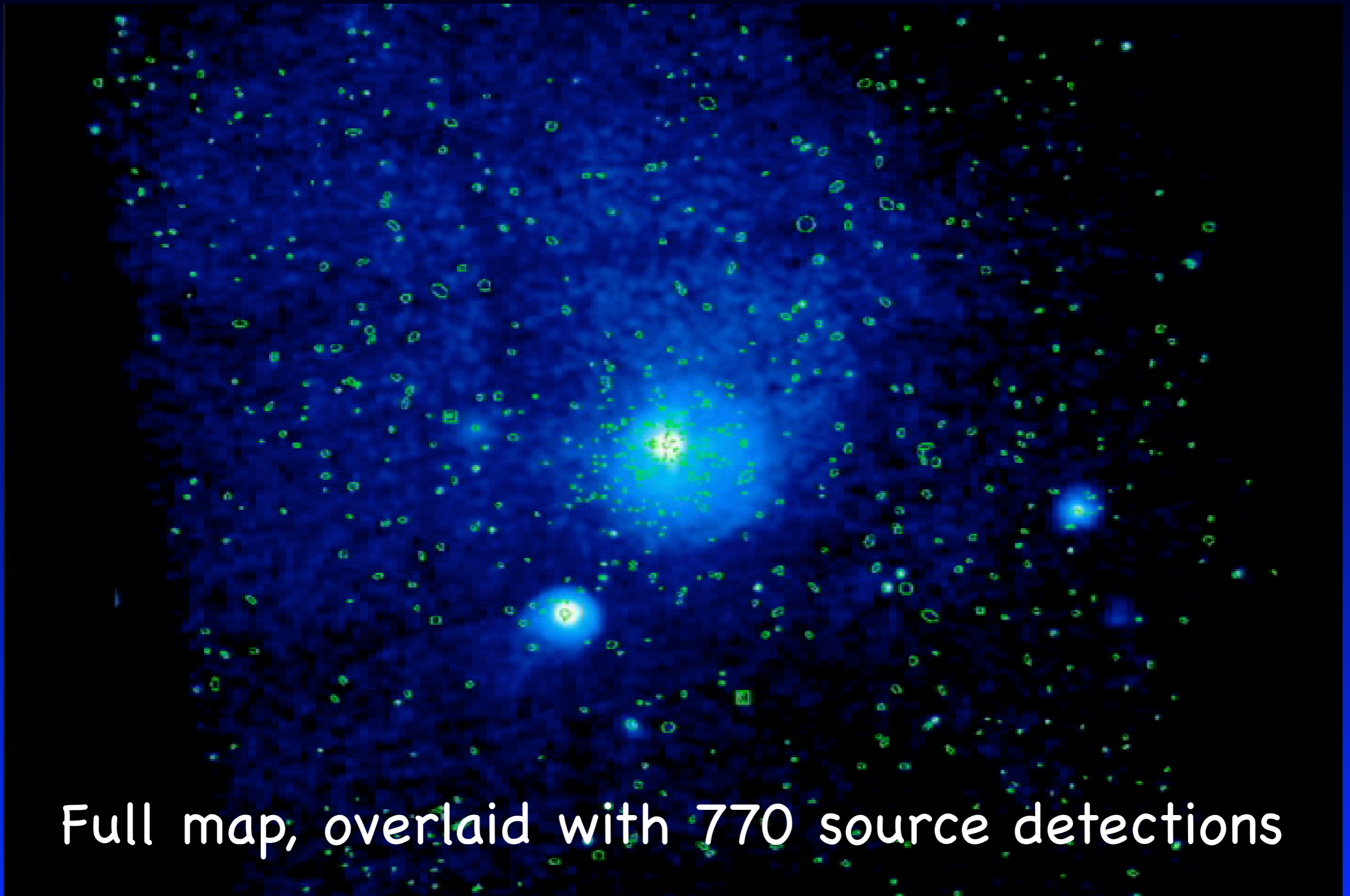
The Chandra Fornax Survey (0.5Msec, 10 fields)



Pan to NGC1404, infalling, cometary emission

Scharf, Zurek, Bureau (2004)

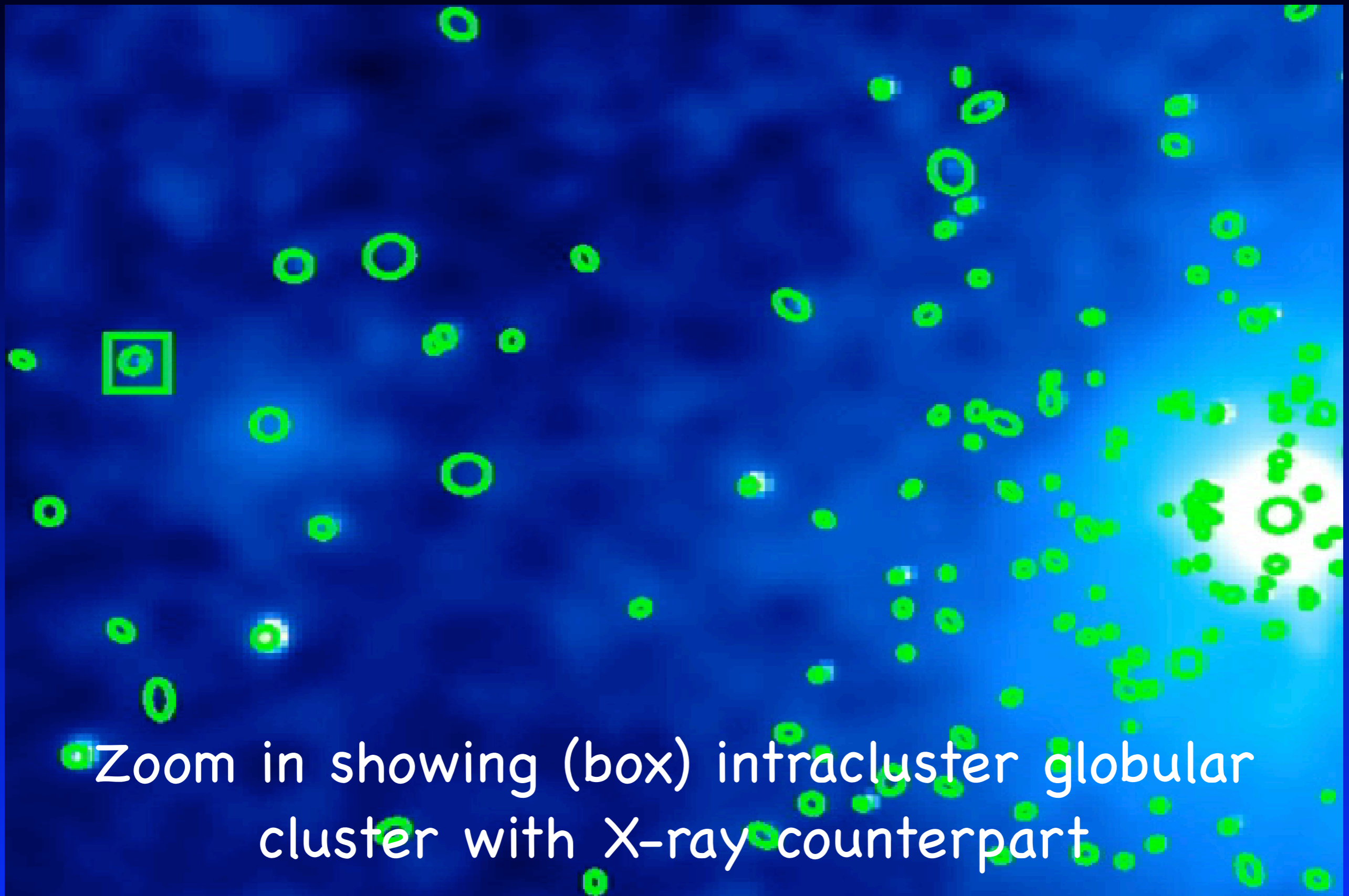
The Chandra Fornax Survey (0.5Msec, 10 fields)



Full map, overlaid with 770 source detections

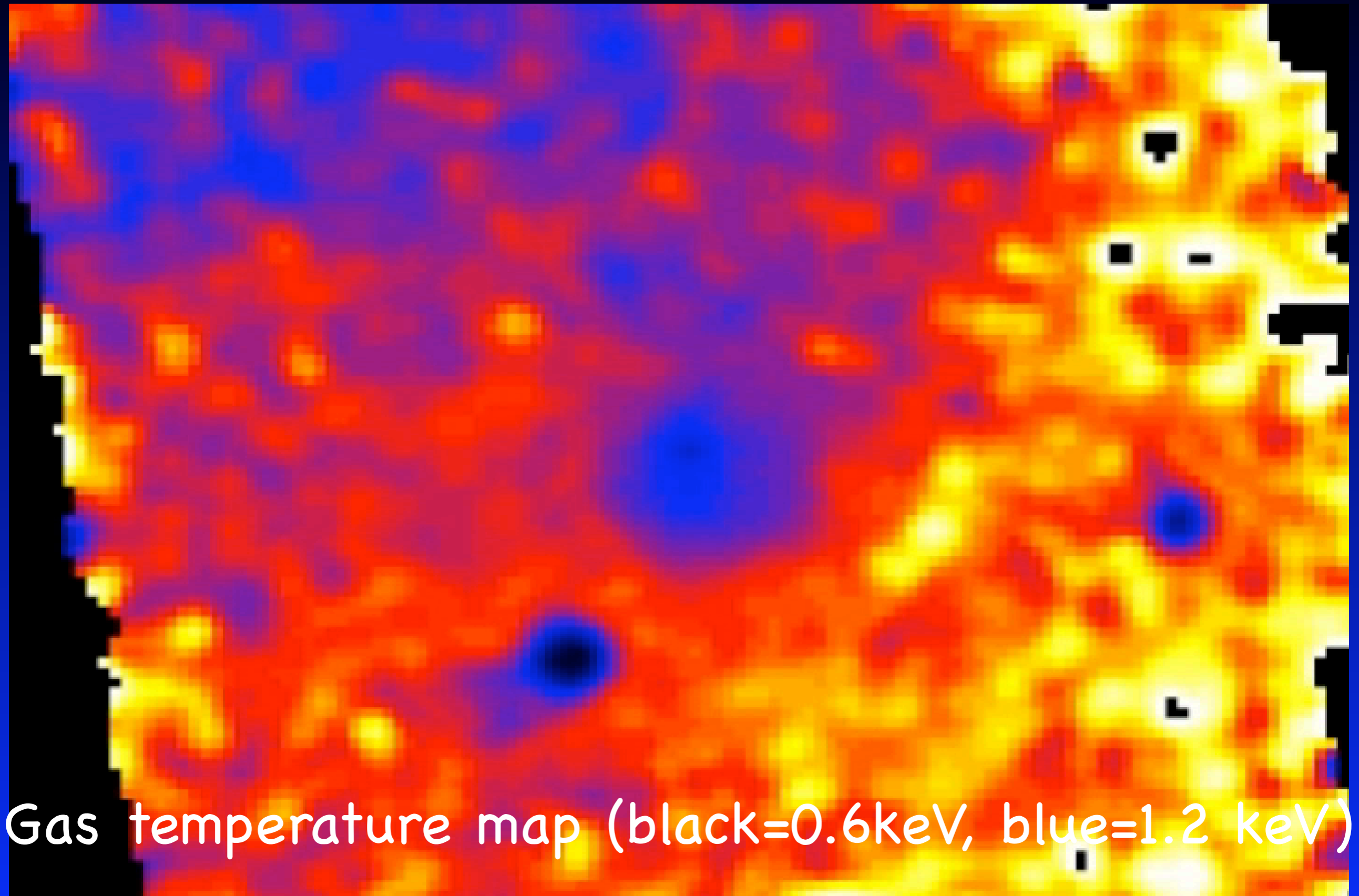
Scharf, Zurek, Bureau (2004)

The Chandra Fornax Survey (0.5Msec, 10 fields)



Scharf, Zurek, Bureau (2004)

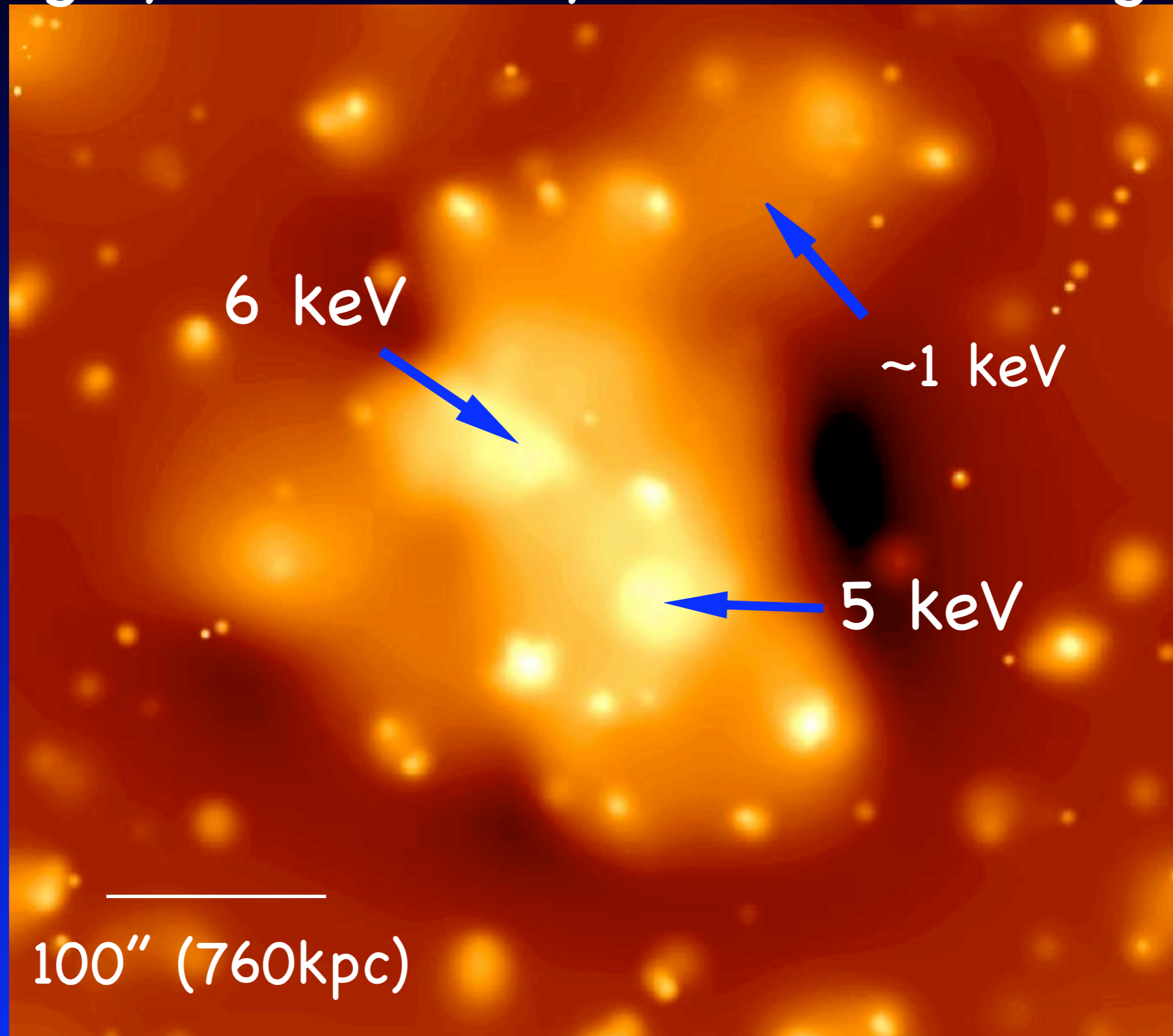
The Chandra Fornax Survey (0.5Msec, 10 fields)



Gas temperature map (black=0.6keV, blue=1.2 keV)

Scharf, Zurek, Bureau (2004)

CL J0152.7-1357 $z=0.833$
Highly Luminous system: 2×10^{45} erg/s



XMM-Newton: 11,000 photon image (Maughan et al 2004)

Dynamical analysis indicates a 0.78 probability that sub-clusters are bound and will merge in ~ 1 Gyr (Maughan et al 2003)

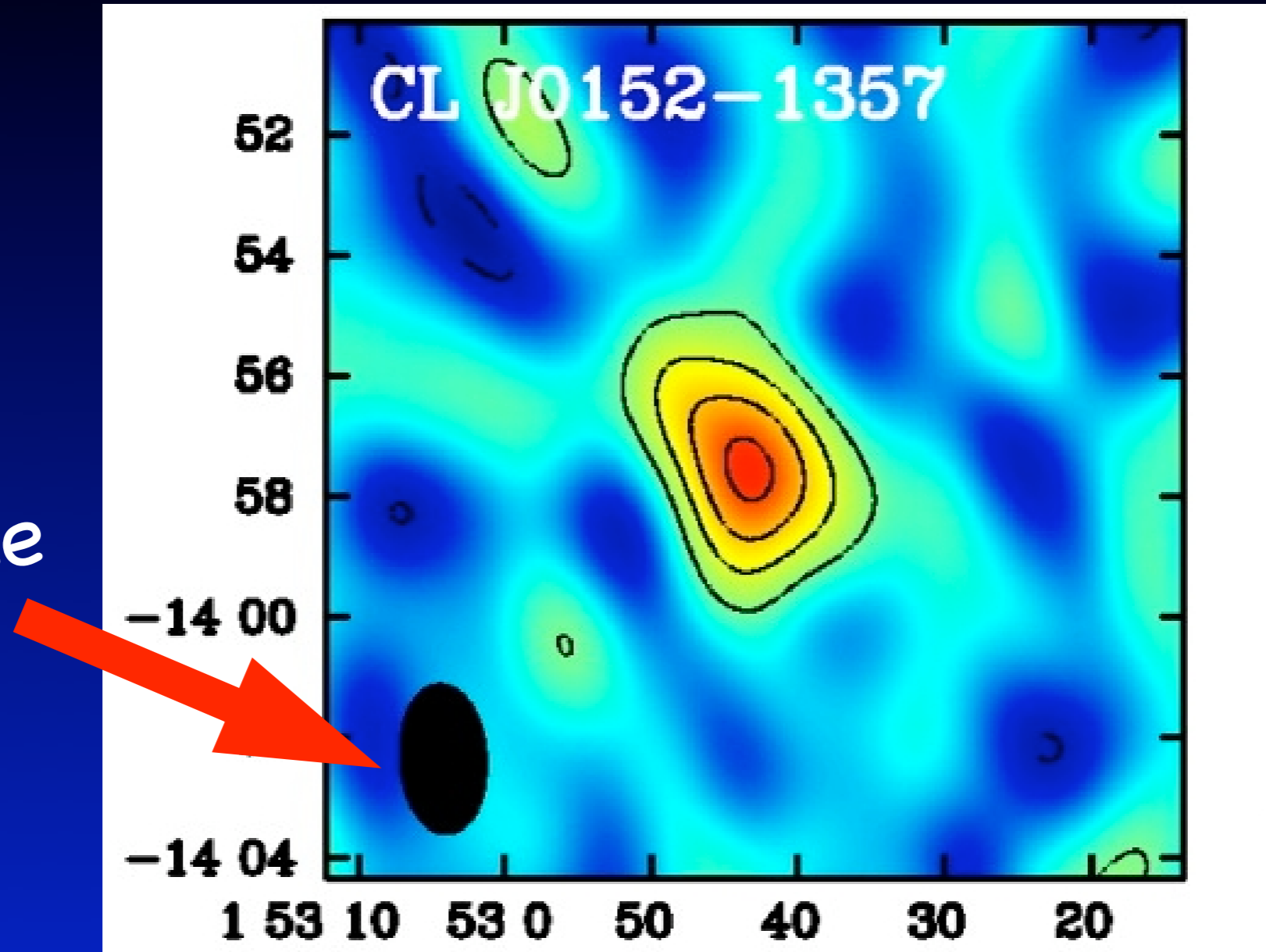
Combined mass: at least $8 \times 10^{14} h^{-1} M_{\odot}$
(each sub-cluster mass within individual r_{200})

If the global mean T were used to estimate the system mass then clearly it would be a factor ~ 0.5 too low

Individually the sub-clusters lie on the canonical L - T relation, if they were unresolved the system would be some $3-4\sigma$ offset

Current SZ map (BIMA circa 2000)

Beam size



Joy et al (2001)

SZ electron temp: $8.7_{(-1.8)}^{(+4.1)}$ keV

Estimated $M \sim 2 \times 10^{14} h^{-1} M_{\odot}$

However, if the X-ray inferred masses are calculated within a radius comparable to that used for the SZ then combined X-ray mass of sub-clusters is $\sim 2 \times 10^{14} h^{-1} M_{\odot}$

So rather remarkably, the unresolved SZ data actually yield the same answer as the X-ray data

...the linear sensitivity of SZ to density is partially responsible – mass estimated from $\rho_e(r)$

However, it is **very** unclear how to count this system in $N(M,z)$, and there's a 20% possibility it's not bound at all.

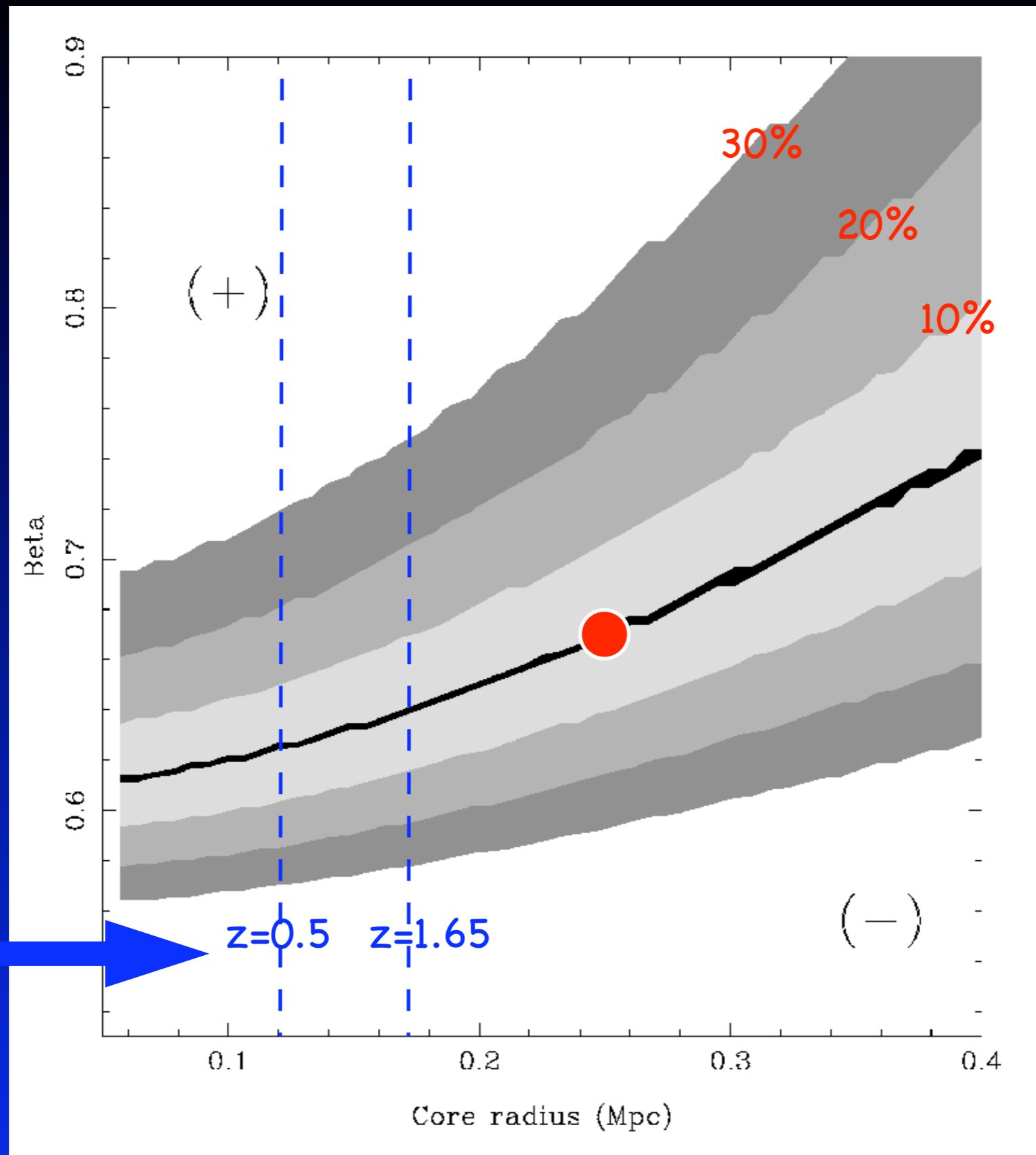
CL0152 is unlikely to be unique

Is this a problem ?

Detection biases: there is no such thing as “purely” flux limited detection (for example)

ROSAT
type
pointed
survey

Detection
volume
errors
from
assuming
wrong
cluster
profile



Physical
resolution
scale of
 $20''$
($H_0=70$)

$$L_x = 5 \times 10^{44}, \Omega_M = 0.3, \Omega_\Lambda = 0.7$$

Are these things really a huge problem ?

No, but you have to deal with them !